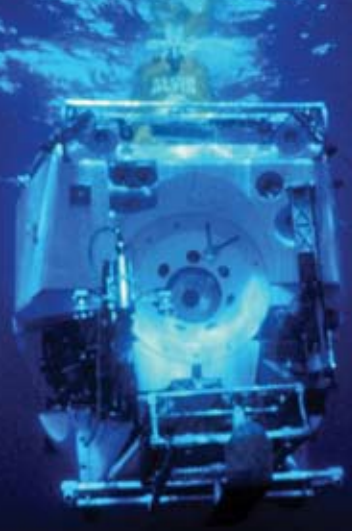
BY BARBARA STAHURA

"NEW EYES" IN THE OCEAN



DSV *Alvin*, perhaps the most active and successful research submersible.
Credit: NOAA Central Library Photo Collection, NURP, Woods Hole Oceanographic Inst., R. Catanach, photographer

No matter where on Earth we live, the ocean contributes to our lives. At the most crucial level, the ocean makes the planet livable by regulating global temperatures and providing oxygen. Beyond that, the sea provides paychecks for millions of families. Its bounty includes myriad life forms and other elements that benefit us through medicine, science, and technology. It is a global highway and food storehouse. It holds valuable energy resources and minerals. It provides recreation and increases tourism in ways that add to our joy and support our economy. Even with all the gifts the ocean has already bestowed, and with all the knowledge we have already gained from it, much more awaits: We have explored less than five percent of it. But with advanced technology, we have "new eyes" to see more of the ocean as we venture further into the deep, dark expanse of this mysterious world.

"We now have marvelous new tools that permit exploration in spatial and temporal dimensions that were unachievable 50 years ago. In other words, we will not only go where no one has ever gone, but we will also 'see' the oceans through a new set of technological 'eyes,' and record these journeys for posterity."

Report of the President's Panel on Ocean Exploration: *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration*

Remote Sensing

The Indian Ocean tsunami of December 2004 could not be seen in the open ocean. Only when the long waves began piling up against coastal slopes did they become all too visible. Yet miles above, radar satellites recorded the tsunami's height as it literally rippled around the world.

Several days later, NOAA scientists, including Walter H.F. Smith, a geophysicist at the NOAA Laboratory for Satellite Altimetry, used the satellite wave-height data to make depth surveys of the ocean floor, something that will lead to models better able to predict the hazardous effects of tsunamis. Such radar measurements of sea level variations taken from space already are used to make simple charts of unexplored ocean basins and, along with other remote-sensing techniques, can forecast hurricane intensity, the onset of an El Niño, and other weather and climate events. Through the Integrated Ocean Observing System now under development, NOAA and other agencies will be able to deliver enhanced information about the ocean's activities, protecting more lives and property from harm.

A NOAA-supported mission used new and unobtrusive cameras and lights to image deep-sea animals such as this 3-foot fluorescent cat shark at more than 1,800 feet deep. *Credit: Deep Scope 2005 Science Team*

Underwater Vehicles

Underwater research vehicles are nothing new. Submarines and small submersibles such as Woods Hole's Deep Submergence Vehicle *Alvin* and the *DeepWorker* have been exploring ocean depths for decades on NOAA-sponsored missions and others. Manned submersibles offer some distinct advantages over undersea robots, including the depth perception of a scientist's vision as he or she looks through the sub's viewport. But the operational time of manned submersibles is limited largely by the humans inside. Furthermore, propulsion systems and thruster engines are often noisy, and their lights are very bright so as to accommodate human eyes and cameras, making them disruptive to marine creatures not accustomed to such an intrusive visitor in their watery world. A newer generation of underwater vehicles has greatly enhanced underwater exploration capabilities.

These are remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and hybrid remotely operated vehicles (HROVs). These tethered and untethered vehicles have taken their place in the inventory of tools now available to ocean explorers and researchers.

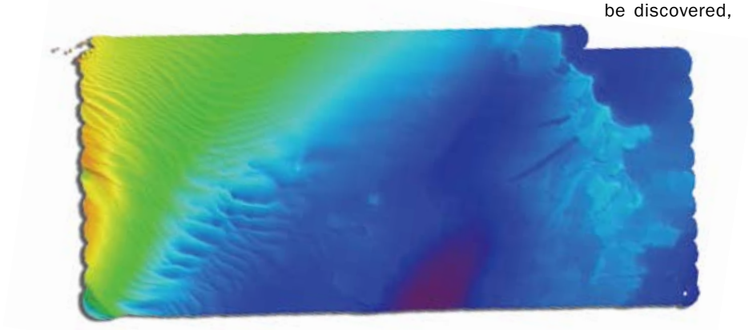
NOAA deploys manned submersibles, ROVs, and AUVs on a variety of missions, and is helping to fund an HROV. The unmanned, underwater robots known as ROVs were first developed for industrial uses, such as underwater pipeline inspection. But their use soon expanded into the scientific arena, adding a new dimension to ocean exploration. They are controlled by a human pilot on the support ship through a long, armored cable carrying electrical signals, which also acts as a tether. At minimum, most ROVs carry a video camera and lights, giving scientists the opportunity to view real-time video of regions normally far beyond reach. Sampling systems, still cameras, cutting arms, and measuring instruments can be added to the ROV toolbox. The many advantages of exploring with ROVs include much longer bottom times, decreased human risk, use in harsher environments, and lower cost than human transport vehicles.

AUVs have the added advantage of needing neither a tether nor a pilot. Their preprogrammed onboard computers allow them to conduct various underwater survey tasks and video surveillance, then return to the ship. Some are battery powered, while others are gliders without heavy batteries or fuel, or even propellers. These silent undersea probes can travel long distances, gathering information.

The HROV (currently there is only one, in trials) can operate as either a tethered ROV operated by a pilot, or as a free-swimming, programmed AUV. Because of this split personality, it has been dubbed *Nereus*, after the shape-shifting god of ancient Greece. *Nereus* will not require the typical thick ROV cable. Instead, it will use a micro-thin fiber optic tether up to 25 miles long — a handy device when moving laterally under polar ice, for instance. Instead of the Winnebago-sized housing needed to accommodate typical ROV cable, *Nereus'* tether can be gathered into a box the size of a microwave oven. This cable is fragile — even a 9-pound bass would break it — so *Nereus* is programmed to automatically switch to AUV mode should the tether snap.

Able to withstand extreme pressures and frigid cold, it can dive deeper than Mt. Everest is high — to 36,000 feet — and remain submerged for 36 hours. And with its two modes of operation, it will be able to serve a variety of the exploration and research needs of a deep-ocean expedition.

The "Eagle Ray," a deepwater autonomous underwater vehicle (AUV), provides vivid bathymetric imagery of the ocean floor down to depths of 2,200 meters using multi-beam sonar technology. *Credit: NOAA's Undersea Research Program Center at the University of North Carolina at Wilmington* **Below: Example of mapping from the AUV.** *Credit: NOAA's Undersea Research Program Center at the University of North Carolina at Wilmington*

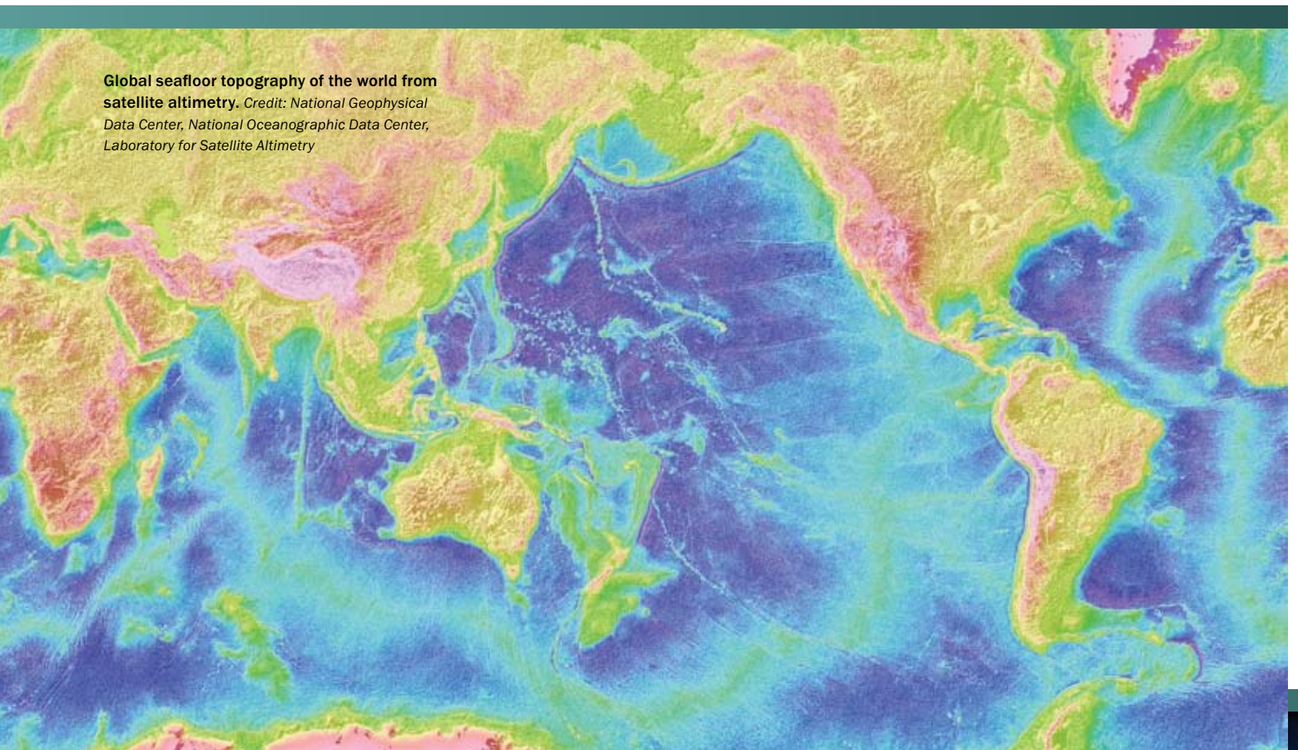


Unobtrusive Eyes

NOAA has worked with Harbor Branch Oceanographic Institution and others to support a series of "Deep Scope" missions that test "new eyes" in the ocean — unobtrusive, innovative, and advanced camera systems, for example, that make it easier to see animals under extremely dim light, so that more ocean animals will be discovered, and more will be seen in their natural habitats.

With these incredible devices, undersea exploration is entering an exciting new era. While the ocean may never be completely explored, we will be able to solve many more of its mysteries in coming years, with "new eyes" in the ocean.

NOAA Oean Explorer: Operation Deep Scope 2005 — www.oceanexplorer.noaa.gov/explorations/05deepscope/welcome.html



Global seafloor topography of the world from satellite altimetry. *Credit: National Geophysical Data Center, National Oceanographic Data Center, Laboratory for Satellite Altimetry*